8 miles, but here the data are less complete. The velocity of the shock is estimated at nearly 5200 metres a second. Large numbers of observations are recorded and discussed in their practical and theoretical bearings, and the memoir is enriched by numerous illustrations, which, as usual, are admirably executed.

The second memoir, by Prof. N. S. Shaler, describes the geology of the district about Cape Ann (Massachusetts). This district consists entirely of igneous rocks, but it affords exceptional advantages for the study of dykes, of the phenomena of joints, and of the superincumbent drift, while on its coasts the relation of wave-work to ice-work can be readily examined. This memoir, as might be anticipated, is not of such exceptional interest as the preceding one; the illustrations, however, are excellent, and in several cases will be valuable to students who cannot travel far afield.

The third memoir, by Mr. W. H. Weed, "On the Formation of Travertine and Siliceous Sinter by the Vegetation of Hot Springs," is one of much general interest. A large number of facts have been collected and co-ordinated by the author, which establish, as he believes, the following conclusions: (*a*) that the plant-life of the calcareous Mammoth Hot Springs waters causes the deposition of travertine, and is a very important agent in the formation of such deposits; (*b*) the vegetation of the hot alkaline waters of the geyser basins eliminates silica from the water by its vital growth, and produces deposits of siliceous sinter; (*c*) the thickness and extent of the deposits produced by the plant-life of thermal waters establishes the importance of such vegetation as a geological agent. The effect of organisms in promoting mineral accumulation, indirectly by decomposition after death, or directly during life, has long been recognized, but it is interesting to find that some algæ, like some corals, may claim to be called "reef-builders."

A short memoir on the geology and physiography of a part of North-Western Colorado, Utah, and Wyoming concludes the volume. As may be inferred from our brief outline of its contents, it is not less interesting than any one of its eight predecessors, and it abounds in illustrations admirably executed. In this respect, unfortunately, geological works published in Great Britain cannot be compared with those of the United States of America. T. G. Bonney.

## OUR BOOK SHELF.

*On the Eggs and Larvæ of some Teleosteans.* By Ernest W. L. Holt. (Transactions of the Royal Dublin Society, Vol. IV. Part 7, February 1891.)

In 1890 the Royal Dublin Society appointed a Committee for the purpose of investigating the fishing grounds on the west coast of Ireland, and they voted a considerable sum of money for the cost of the expedition. This sum was increased by a vote in aid from the Irish Government, who thus properly assisted the efforts of a private Society in attempting a work of great general utility. Here it is not our intention to refer in any detail to the general work done during the last year by the expedition, which was under the charge of several well-known biologists, and which we are glad to learn is being continued this year, under even more favourable auspices than before; but to call attention to a report by Mr. Ernest Holt on the eggs and larvæ of some Teleosteans met with in the first year's cruise. The ova were collected between June 12 and July 11, 1890, and the observations made thereon, with the series of beautiful drawings now before us, were laid before the Royal Dublin Society in November of the same year, while the memoir itself was published in February last. All the observations and drawings of the living forms were made on board ship, but the bad weather generally encountered during the cruise left much to be desired in the way of facilities for microscopical study. It must also be remembered that the main object of the expedition was an inquiry into the presence of "fish grounds," into the condition of the reproductive organs and food of adult fishes, and that these special researches of Mr. Holt were conducted only in such time as could be spared from these other duties.

Under all these circumstances it is surprising that so much good work was done, the ova of twenty-two forms having been more or less carefully investigated. Most of these were pelagic ova. The methods used for their capture were: (1) towing at the surface small ring-nets of fine cheese cloth at the sides of the vessel whilst trawling; (2) sinking larger ring-nets and a large triangular midwater net, after Prof. McIntosh's pattern, to a fathom or so below the surface, and allowing the ship to drift with them for a short time; (3) trawling from the ship's boats with a small naturalist's trawl with muslin net—owing probably to some defect in the latter, this method was not very successful. The first method proved by far the most productive. The following were the species examined. The ova and larvæ of those with an asterisk are figured in detail in the plates. *Scomber scomber*, **Trachinus vipera*, *Trigla gurnardus*, **Gobius niger*, **Callionymus lyra*, **Cepola rubescens*, **Lepadogaster bimaculatus*, *Labrus maculatus*, *Crenilabrus melops*, *Merluccius vulgaris*, *Macrurus* (?), **Rhombus lævis*, **Pleuronectes microcephalus*, *P. cynoglossus*, *Clupea sprattus*, **Solea* (?), **S. lutea* (?), **A. Motella*-like form, **Ctenolabrus rupestris* (?), **A Coris*-like form, and four unidentified forms which are figured. There is also a table showing the comparative dimensions of the ova.

This memoir forms a very important contribution to the history of the development of our native fish, and is exceedingly well printed and illustrated.

*The Hand-book of Games.* Vol. II. Card Games. New Edition. (London: George Bell and Sons, 1891.)

THE first volume of this work dealt with table games, while the present one treats entirely of card games. Of the twenty-two games here described, eleven are new, or we should rather say did not appear in the first edition, and several of the old games, such as Boston, quinze, lansquenet, &c., which have become obsolete, are omitted.

The game that stands above all others is undoubtedly whist, and to play it well requires no small amount of scientific reasoning. Bearing this in mind Dr. William Pole treats of it in a very able manner, laying before the reader a good account of the game as it is played to-day. In a general view of the modern game, he points out that it was Edmund Hoyle's book which, in 1743, was the first to bring the game to a definite shape. Then followed William Payne's "Maxims," published in 1770, and T. Mathews's "Advice to the Young Whist Player," written in 1800. It is in these three books that the game as then played is fully described. In the later works of "Cavendish" and Clay, the game now known as "modern whist" is expounded, and the author, by making a judicious use of all the above-mentioned authorities, has, in the space of about 100 pages, written both an instructive and refreshing essay on the subject in question.

In regard to the other games treated of, we may note that they are all written by the best authorities. Thus solo

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whist is dealt with by Robert F. Green, piquet, écarté, euchre, bézique, and cribbage by "Berkeley," and the round games, including napoleon, loo, &c., by Baxter-Wray. Although we have only just mentioned these games by name, it must be understood that each is thoroughly well described, and numerous illustrations for the explanation of difficult hands are inserted. The work will be most popular as a book of reference; and we may add that those who wish only to be instructed in one or two games in particular can obtain different sections in separate volumes.

*Object-Lessons from Nature: a First Book of Science.* By L. C. Miall, Professor of Biology in the Yorkshire College, Leeds. (London: Cassell and Co., Limited, 1890.)

THIS little volume is a very laudable attempt to form a first guide to the study of Nature for children; the lessons are meant to serve as guides to the intelligent teacher, who should in a half-demonstrative, half-catechetical way, bring the various subjects treated of before the young pupil's mind. Throughout there is no attempt to teach the student that there are a number of different sciences, but the various natural phenomena witnessed in the history of a "summer shower," in the "burning of a candle," or the "growth of a plant or insect," are gradually led up to, the various stages in the story of each being explained as they arise. Teachers must use their personal experience in illustrating their teachings, as based on these lessons, and those who are able to use the chalk and blackboard will find an immense advantage in doing so, as the little student's attention is thereby doubly attracted, and a much greater impression is made upon his mind.

## *LETTERS TO THE EDITOR.*

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

### The International Congress of Hygiene and Demography.

AS I notice that you give an excellent account of the meeting of the General Committee of this Congress recently held under the presidency of H.R.H. the Prince of Wales, I have no doubt that your readers will be interested to know how the Congress came to be invited to hold its session in London this year.

In 1884 I was asked by the Organising Committee of the Congress to be held at The Hague that year to give an address at a general *séance* of the Congress; I did so, selecting as my subject "La Science Ennemie de la Maladie." During the meeting of that Congress, one of the most pleasant that I ever attended, I was frequently asked why we had never invited the Congress to London, and I was obliged to answer that our Government would give no pecuniary assistance for such a purpose, and that we had no Hygienic Society strong enough to undertake it; but I determined that anything I might be able to do to bring about that result should be done, as I felt that it was a disgrace to this Country that this Congress, of all others, had not met here.

The next Congress was to be held in Vienna in 1886, but was postponed until 1887, and in that year my opportunity came in the proposed amalgamation of the Sanitary Institute of Great Britain and the Parkes Museum. I urged the importance of the matter on the Councils of both those bodies, and induced them to pass resolutions inviting the Congress to hold its next session in London. Sir Douglas Galton (as Chairman of both Councils) and I were appointed delegates to attend the Congress at Vienna, and present the invitation; the Society of Medical Officers of Health was also asked to co-operate, and appointed Mr. Shirley Murphy as its delegate. We three went to Vienna, and presented the invitation, which was accepted. After our return to this country we set to work to form, with the aid of the other English members of the Vienna Congress, especially Sir Spencer Wells, Prof. (now Sir George) Humphry, Dr. Cameron, M.P., Prof. Frankland, and Dr. Mapother, the large and influential General Committee.

In the early days it was thankless and rather trying work, especially as the money did not come in as readily as we could have wished; but now, thanks to the patronage of Her Majesty the Queen, to the presidency of His Royal Highness the Prince of Wales, and to the support of the Lord Mayor and Corporation of the City of London, it is comparatively plain sailing, and there can be no doubt that the Congress will be a great success, to which no one will have contributed more than Sir Douglas Galton, the indefatigable Chairman of the Organising Committee. To ensure this, however, and to enable us to bear the heavy expense of printing the Transactions, &c., funds are still urgently needed. I may add that all general correspondence relating to the Congress should be addressed to Dr. G. V. Poore, the Hon. General Secretary, at the offices, 20 Hanover Square, W.

W. H. CORFIELD,
Hon. Foreign Secretary.

19 Savile Row, W., March 28.

### On the Rôle of Quaternions in the Algebra of Vectors.

THE following passage, which has recently come to my notice, in the preface to the third edition of Prof. Tait's "Quaternions," seems to call for some reply:

"Even Prof. Willard Gibbs must be ranked as one of the retarders of quaternion progress, in virtue of his pamphlet on 'Vector Analysis,' a sort of hermaphrodite monster, compounded of the notations of Hamilton and of Grassmann."

The merits or demerits of a pamphlet printed for private distribution a good many years ago do not constitute a subject of any great importance, but the assumptions implied in the sentence quoted are suggestive of certain reflections and inquiries which are of broader interest, and seem not untimely at a period when the methods and results of the various forms of multiple algebra are attracting so much attention. It seems to be assumed that a departure from quaternionic usage in the treatment of vectors is an enormity. If this assumption is true, it is an important truth; if not, it would be unfortunate if it should remain unchallenged, especially when supported by so high an authority. The criticism relates particularly to notations, but I believe that there is a deeper question of notions underlying that of notations. Indeed, if my offence had been solely in the matter of notation, it would have been less accurate to describe my production as a monstrosity, than to characterize its dress as uncouth.

Now what are the fundamental notions which are germane to a vector analysis? (A vector analysis is of course an algebra for vectors, or something which shall be to vectors what ordinary algebra is to ordinary quantities.) If we pass over those notions which are so simple that they go without saying, geometrical addition (denoted by +) is, perhaps, first to be mentioned. Then comes the product of the lengths of two vectors and the cosine of the angle which they include. This, taken negatively, is denoted in quaternions by $S\alpha\beta$, where $\alpha$ and $\beta$ are the vectors. Equally important is a vector at right angles to $\alpha$ and $\beta$ (on a specified side of their plane), and representing in length the product of their lengths and the sine of the angle which they include. This is denoted by $V\alpha\beta$ in quaternions. How these notions are represented in my pamphlet is a question of very subordinate consequence, which need not be considered at present. The importance of these notions, and the importance of a suitable notation for them, is not, I suppose, a matter on which there is any difference of opinion. Another function of $\alpha$ and $\beta$, called their product and written $\alpha\beta$, is used in quaternions. In the general case, this is neither a vector, like $V\alpha\beta$, nor a scalar (or ordinary algebraic quantity), like $S\alpha\beta$, but a quaternion—that is, it is part vector and part scalar. It may be defined by the equation—

$$\alpha\beta = V\alpha\beta + S\alpha\beta.$$

The question arises, whether the quaternionic product can claim a prominent and fundamental place in a system of vector analysis. It certainly does not hold any such place among the fundamental geometrical conceptions as the geometrical sum, the scalar product, or the vector product. The geometrical

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